MJ:kdn 05/20/02 6541-60632 114177

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Docket: 6541-60632	App: 09/168,919
	Applicant: Amin et al.	
	Filed: October 9, 1998	Art Unit: ~~2781~~ 2665

U.S. PATENT DOCUMENTS

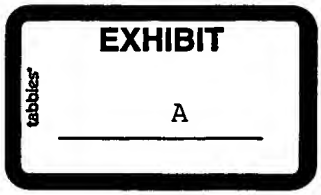
Init.*		Number	Date	Name	Class	Sub	Filed
RS		5,155,742 ✓	10/1992	Ariyavisitakul et al.			
RS		5,436,899 ✓	7/1995	Fujino et al.			
RS		5,511,110 ✓	4/1996	Drucker			
RS		5,539,744 ✓	7/1996	Chu et al.			
RS		5,577,046 ✓	11/1996	Diachina et al.			
RS		5,625,629 ✓	4/1997	Wenk			
RS		5,287,348	2/15/94	Schmidt et al.			
RS		5,455,823	12/3/95	Noreen et al.			
RS		5,381,412	1/10/95	Otani			

OTHER DOCUMENTS

	✓		"Software for a United States TDMA System Cellular Portable Telephone," Oki Technical Review, pp. 59-62 (Dec. 1995).

EXAMINER: [signature] DATE 8-21-02

*Examiner: Initial if considered, whether or not in conformance with MPEP 609; draw line through cite if not in conformance and not considered. Send copy.



MJ:kdn 05/20/02 6541-60632 114177

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Docket: 6541-60632	App: 09/168,919
	Applicant: Amin et al.	
	Filed: October 9, 1998	Art Unit: 2781

U.S. PATENT DOCUMENTS

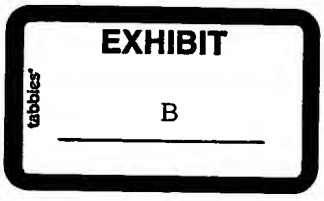
Init.*		Number	Date	Name	Class	Sub	Filed
		5,155,742	10/1992	Ariyavisitakul et al.			
		5,436,899	7/1995	Fujino et al.			
		5,511,110	4/1996	Drucker			
		5,539,744	7/1996	Chu et al.			
		5,577,046	11/1996	Diachina et al.			
		5,625,629	4/1997	Wenk			
		5,287,348	2/15/94	Schmidt et al.			
		5,455,823	12/3/95	Noreen et al.			
		5,381,412	1/10/95	Otani			

OTHER DOCUMENTS

			"Software for a United States TDMA System Cellular Portable Telephone," Oki Technical Review, pp. 59-62 (Dec. 1995).

EXAMINER:	DATE

*Examiner: Initial if considered, whether or not in conformance with MPEP 609; draw line through cite if not in conformance and not considered. Send copy.



General Essay: UDC 681.323.06 : [621.395.721.5 : 621.396.931]

Software for a United States TDMA System Cellular Portable Telephone

Jun OKABE*, Takeshi YAMAGAMI**

Abstract

In the United States, a control channel digitization standard (IS-136) was established by TIA last year to increase channel capacity, providing such new services as private systems and short message services, and to save energy for portable phones by adopting a paging class. This paper presents an overview of the IS-136 standard, and the functions required for software from a communication protocol point of view, as well as the configuration of software for TDMA cellular portable phones, now under development to implement the above functions.

1. Introduction

The cellular telephone system in the United States started in 1983 with the commercialization of an analog cellular system. Operation of a digital system began in 1993 with the TDMA (Time-Division Multiple Access) system. This digital system is a dual-mode system which analogically controls outgoing and incoming calls and digitally carries the voice signals. The first completely digitized system with a digitized control channel was standardized in December 1994 by the TIA (Telecommunications Industry Association). Work to supplement functions for this standard is advancing and nearing commercialization.

Due to the remarkable increase in the demand for portable telephones in metropolitan areas, analog systems (FDMA: Frequency-Division Multiple Access) are becoming unable to cover the increase in the number of subscribers. The commercialization of digital systems, which efficiently utilize frequencies, is progressing. Standardization of the TDMA system and CDMA (Code-Division Multiple Access) system is being carried out at the TIA, and the improvement or building of both systems is continuing.

In this background, the digitizing of the control channel by means of the TDMA system is stipulated by the IS-136 standard. This standard provides new services such as call control, short message service (SMS) and private network service (private system).

This paper describes an overview of the IS-136[1] standard from the software viewpoint, and describes the software for a TDMA cellular portable telephone which OKI Electric is currently developing to implement this standard.

2. Overview of United States TDMA System

The United States TDMA system already implements digital voice (dual-mode) based on the IS-54B standard.[2] Since the communication capacity is limited by the capacity of the analog control channel, digitizing of the control channel and standardization of the voice channel data transmission are advancing. Figure 1 shows the relationships between standards in the TDMA system. Table 1 shows the main specifications of both systems.

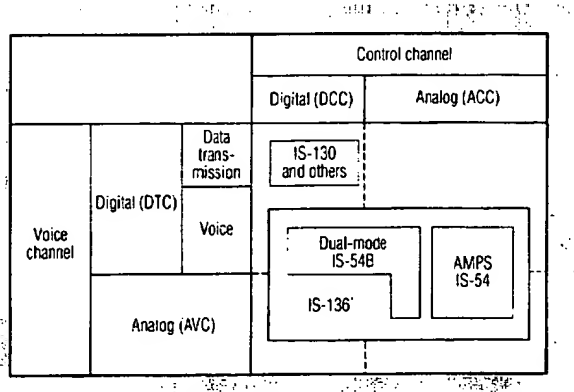
The following four points are the principal aims of digitizing the control channel:

1. To increase the capacity of the control channel (ten times analog capacity).
2. To provide new applications (private network service).
3. To provide a message service (SMS: short message service).
4. To reduce power consumption of portable phones by adoption of paging class.

The IS-136 standard stipulates a wireless interface between the base station and the mobile phone (cellular portable telephone terminal, car terminal). The communication protocol comprises the following four layers:

1. Higher Layers

Performs the message transfer service for SMS, and the paging service. The SMS communication configuration includes a point-to-point communication mode and a multiple address communication mode.



DCC: Digital Control Channel DTC: Digital Traffic Channel
ACC: Analog Control Channel AVC: Analog Voice Channel
Note 1: The IS-136 standard stipulates support for both analog and digital.

Figure 1. The United States TDMA system standard

* Communication Networks Operations Division, OTG Engineering Center Manager, Engineering Department 2
** Communication Networks Operations Division, OTG Engineering Center Engineering Department 2, Manager, Section 3

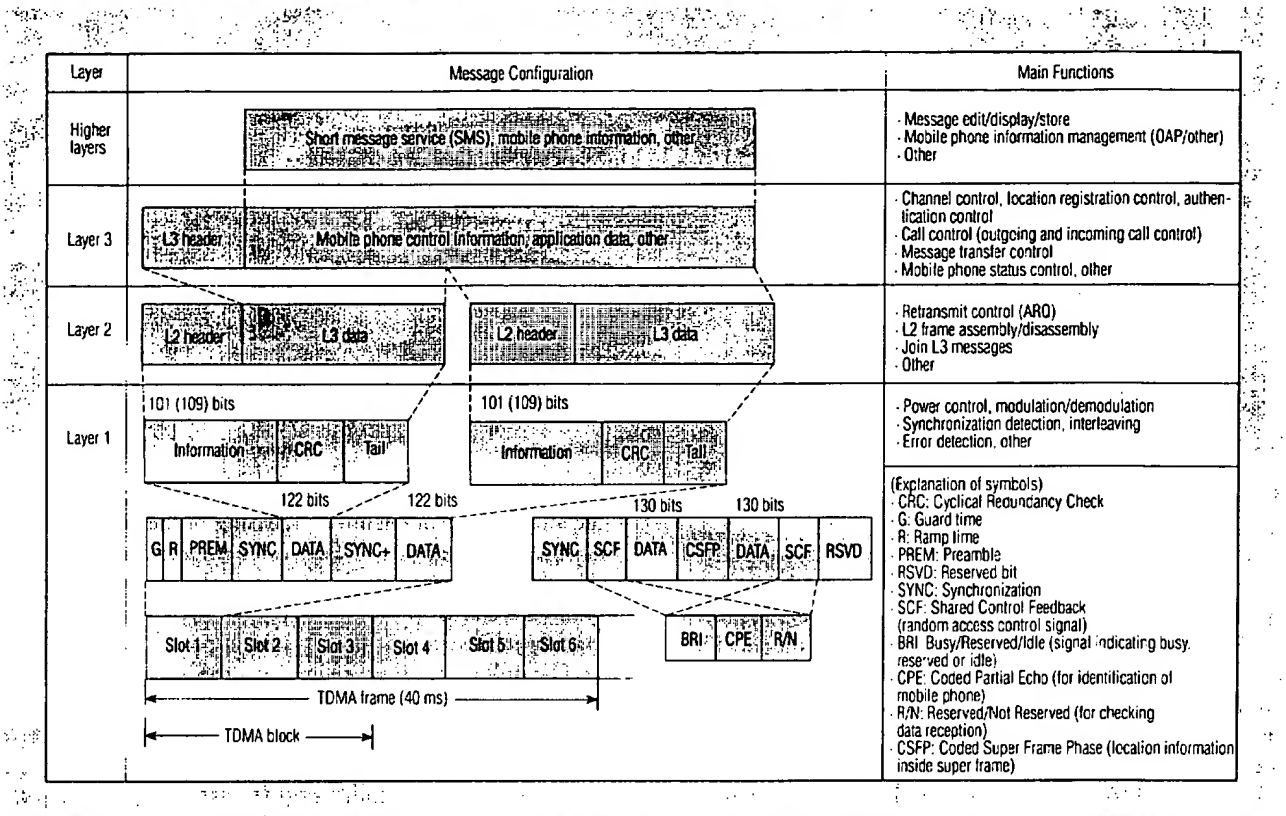


Figure 2: Support for protocol layer functions and messages

2. Layer 3
   Controls the portable phone, e.g., outgoing and incoming calls, and location registration.
3. Layer 2
   Performs disassembly, assembly and retransmission control of layer 3 messages by a data link with the base station.
4. Layer 1
   Establishes frame synchronization, processes coding and controls TDMA.

Figure 2 shows the correspondence between the protocol layer functions and messages. Further, Figure 3 shows the frame configuration of the control channel, and Table 2 shows the channel types and their functions.

3. Software Development

The software for a cellular portable telephone has the following requirements:

1. Should be functionally expandable.
   Since we can expect the demand for an increasing variety of functions with the deployment of a digitized system in the future, it is necessary to be able to easily add to the program and the program should have a flexible structure.
2. Since the memory capacity used by the program affects the equipment size and cost, memory requirements should be minimized.
3. Power consumption should be reduced.
4. The user interface should be substantial.
   The adoption of software keys for a variety of user operations, such as for message communications, is demanded.

Standards organization	TIA
Frequency bandwidth used	800 MHz
Channel spacing	30 kHz
Voice coding system	VSELP
Modulation system	$/4 Shift QPSK

Table 1: Main specifications of the United States TDMA system

The protocol specification of the TDMA system is stipulated hierarchically; the program structure and function apportionment of each program is configured along a hierarchical structure, and a multitasking monitor is adopted. The functions of the portable phone software can be divided largely into paging control and the user interface. This software comprises the following programs:

1. User Interface
   Performs user operations such as outgoing and incoming calls, abbreviated dialing registration/reference, volume adjustment, etc. In order to simplify user operation, a menu display based on icons is used, and software keys, whose functions change for each operation function, are employed. At the same time, a large display device is employed as the screen display in order to make messages easy to read. Ease of operation is also enhanced by the display of appropriate operation instructions.

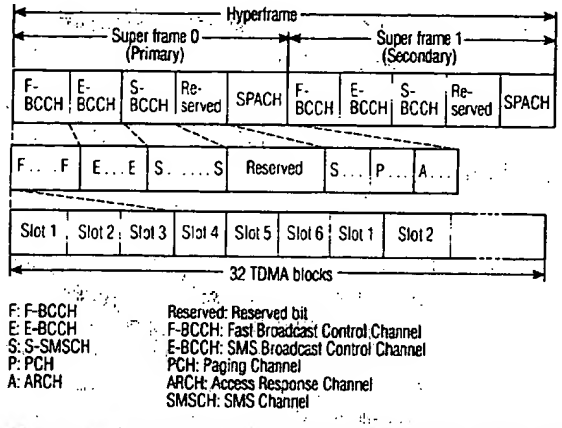


Figure 3: Frame configuration

Channel	Type	Function	Transmission direction
F-BCCH		Used to transmit parameters needed to access the system and the structural variables of the control channel.	
E-BCCH		Used to transmit notification information from the F-BCCH which is not time-critical.	
S-BCCH		Used for multiple address SMS (short message service).	Base station Mobile station
	PCH	Used for paging and order transmission.	
SPACH	ARCH	Used to reply to access from a mobile station.	
	SMSCH	Used for point-to-point SMS transmission.	
RACH		Used for accessing the base station, e.g., Call request.	Mobile station Base station

Table 2: Channel types and their functions

2. Call Processing
   Controls the protocol stipulated by the IS-136 standard. It comprises four tasks and various drivers:
   a. Higher Layer Task
      Executes SMS and other applications.
   b. Layer 3 Task (L3DXC)
      Performs layer 3 control of the digital control channel (DCC) and the digital traffic channel (DTC), and measurement of the wireless signal strength.
   c. Layer 2 Task (L2DXC)
      Performs layer 2 control of the DCC and DTC.
   d. AMPS Task
      Controls the analog control channel (ACC) and analog voice channel (AVC).
   e. DSP/RF Driver
      Comprises control of the DCC, DTC and AMPS; controls the digital signal processor (DSP), which performs code processing, and also controls the wireless frequency control hardware.

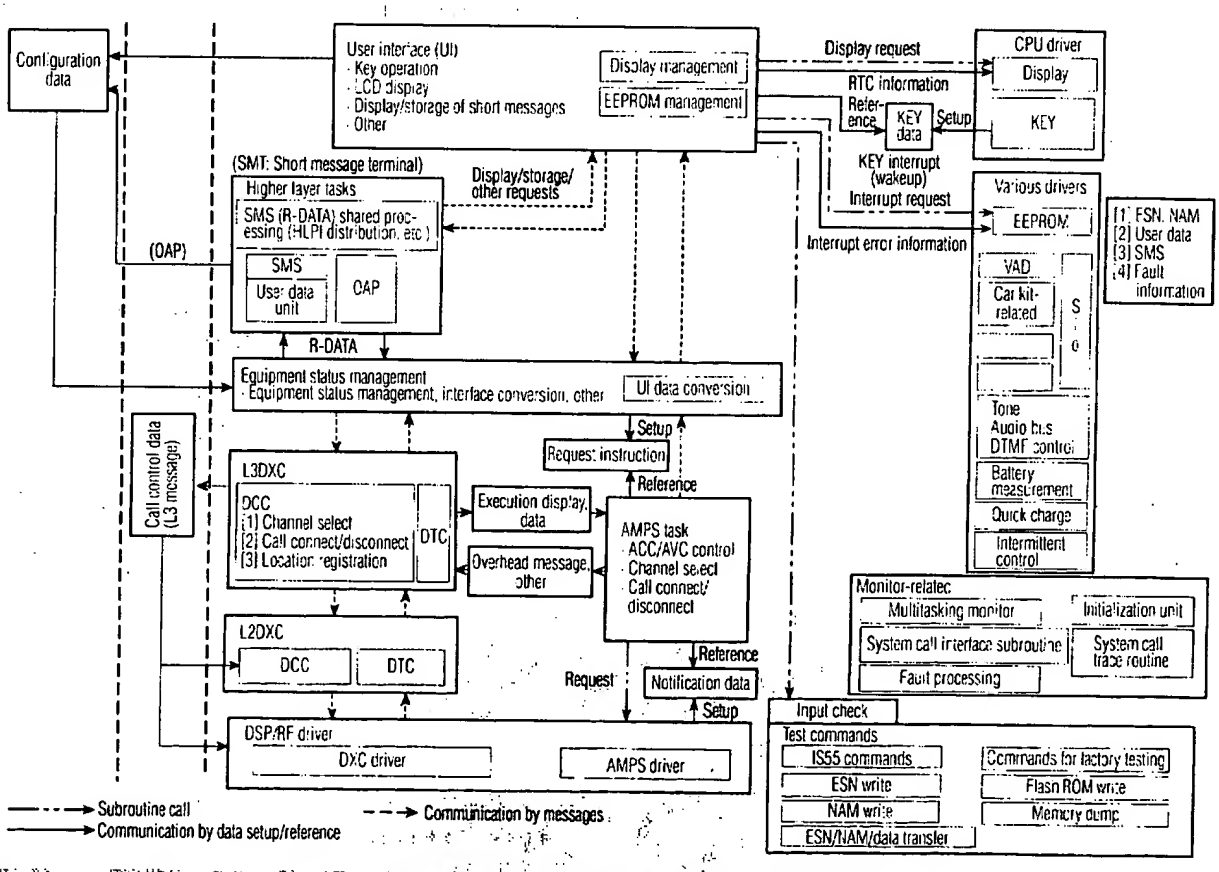


Figure 4: Software structure of TDMA portable phone

3. Peripheral I/O Control
   Comprises the drivers which control the peripheral I/O hardware such as the LCD display, key operation, tone generation, accessories connected to the external connector terminal, etc.
4. Equipment Control
   Performs status management for all equipment. In addition, it also interfaces with the call processing program and the higher layer/user interface programs.
5. Maintenance
   Maintenance comprises a support program used when performing maintenance and fault analysis of equipment specific data.

It also has an intermittent reception function which periodically cuts the power of the main equipment functional elements during standby (incoming standby state), in order to conserve battery power.

Figure 4 shows the software configuration of the TDMA cellular portable telephone. From the perspective of processing speed and memory efficiency, assembly language was used as the development language for hardware control and the IS-136 call control section. Further, C language was used for the user interface in order to enable the efficient development of supplementary functions in the future.

The following three types of memory are used:

1. Flash ROM
   This memory stores to the program code. Flash ROM was adopted in order supplement program functions and to deal with faults.
2. RAM
   This memory is used as the work area for executing the program.
3. EEPROM
   This memory stores equipment-specific information (telephone number, serial number, etc.), abbreviated dialing numbers (user data), and short messages.

4. Conclusion

OKI Electric is presently conducting development of an IS-136 compliant portable telephone. We participated in the interconnection verification test held by the TDMA forum of the TIA, and obtained favorable results in this test. We plan to complete testing of the lower layers at the TDMA forum, and conduct successively higher layer testing as well as field testing.

We also plan to pursue a program control method to achieve yet further reductions in power consumption.

5. References

1. EIA/TIA, "EIA/TIA Interim Standard: 800 MHz TDMA Cellular-radio Interface-Mobile Station-Base Station Compatibility-Digital Control Channel," *TIA/EIA IS-136.1, EIA/TIA.*
2. Onodera, Ohashi, "United States TDMA System Cellular Portable Telephone Equipment," *OKI Electric Research and Development,* 162,61,2 (1994):15–18.